Appendix 1: Data extraction and processing to build data frame for analysis

We sourced matrix models from the COMPADRE Plant Matrix Database, downloaded on the 24th of October 2014, this version is included in Appendix 1, (the current version of COMPADRE can be found here). We used a set of constraining criteria to choose matrix models from the 5,672 contained in this version of COMPADRE to allow fair comparisons and to ensure the same set of predictor variables are available for each matrix model.

Each matrix had to:

1. have all relevant meta-data available, namely GPS coordinates, GrowthType, MatrixTreatment, SurvivalIssue, StudyDuration, MatrixEndYear and MatrixStartYear.
2. be parameterised with at least three years of data to enable assessment across temporal variability.
3. have GPS coordinates in COMPADRE reported to at least arc minute precision so that the location of each population could be matched up with climatic variables.
4. have a dimension of at least 3×3 to appropriately account for individual heterogeneity
5. be based on field data that had not been purposely manipulated so as to examine demographic performance under natural conditions
6. be for a species classified as 'herbaceous perennial' 'tree', 'palm', 'shrub' and 'succulent', because sample size of other growth types was too low for our allow analyses. We did not include annuals as their matrix models are based on a shorter temporal reference (i.e. months, seasons) than perennials, where matrix models are built on annual transitions.
7. be denoted as 'Divided' in the 'MatrixSplit' COMPADRE variable.
8. be denoted 'Mean' in the 'MatrixComposite' COMPADRE variable.
9. refer to a single population (i.e. not refer to more than one named population).
10. have a value ≤ 1.05 for the 'SurvivalIssue' COMPADRE variable.
11. we removed populations where the 'MatrixTreatment' COMPADRE variable indicated they were mowed, burnt or had seeds added.
12. we also removed matrices where the 'Observation' COMPADRE variable indicated there was uncertainty in the GPS coordinates or estimates of the vital rates.
13. We remove species *Chamaecrista keyensis* as it was unclear where these populations were located.
14. the species had to be in the phylogeny provided in Appendix 5 of Salguero-Gómez *et al.* (2015).
15. the location of some populations were not represented in the BioClim rater layers (often populations near coast lines), as a result environmental predictors could not be extracted for these populations and they had to be excluded from our data.

These filtering criteria are largely implemented in lines 130–155 of the file '~/Appendix_1_data_extraction_proccessing/data_extraction_and_clean_up.R', Appendix 1. These criteria resulted in 550 matrix models for our analysis, covering 210 plant species from 156 genera, covering both angiosperms and gymnosperms, with populations from tropical regions to the high latitudes. GPS coordinates in COMPADRE are then used to create a spatialPoints data object. This spatialPoints objects is use to extract the climatic variables from the BioClim rater layers (found here) and the Aridity index raster layer (found here). Principal component analysis (PCA) is then used on the matrix element elasticities and temperature BioClim variables. The demographic metrics, population growth rate (λ), coefficient of variation in λ over time, and damping ratio (ρ) are calculated. A data frame is then created with selected COMPADRE variables, temperature PCA scores, bio_15 for each and aridity index for each population, elasticity PCA scores and the three other demographic metrics. This data frame is saved and used for analysis in the file
'~/Appendix_1_model_code_and_plotting/combined_bc_ai_all_responses.Rdata'

References

Salguero-Gómez, R., Jones, O.R., Archer, C.R., Buckley, Y.M., Che-Castaldo, J., Caswell, H., Hodgson, D., Scheuerlein, A., Conde, D.A., Brinks, E. *et al.* (2015) The COMPADRE plant matrix database: an open online repository for plant demography. *Journal of Ecology*, **103**(1), 202–218.